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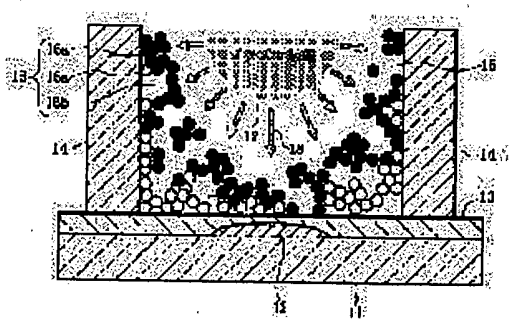
(54) PHOSPHOR FILM STRUCTURE, PASTE FOR FORMING PHOSPHOR FILM AND PLASMA DISPLAY PANEL USING PHOSPHOR FILM

(57)Abstract:

PROBLEM TO BE SOLVED: To increase the luminance of a phosphor film and to reduce the manufacturing cost by forming the phosphor film with many phosphor grains and voids formed between the phosphor grains, and forming the voids in the phosphor film at the ratio of a specific range.



SOLUTION: Voids 16b are formed at the ratio of 40-80% in a phosphor film 16, desirably at the ratio of 50-70%, against 100% when the phosphor film 16 is completely filled with phosphor grains 16a without gaps. When the prescribed voltage is applied between display electrodes, a plasma discharge 17 occurs in a cell 15, and ultraviolet rays 18 generated by this plasma discharge 17 excite the phosphor grains 16a to generate visible light. The ultraviolet rays 18 are irradiated not only to the phosphor grains 16a on the surface of the phosphor film 16 but also to the phosphor grains 16a in the phosphor film 16, the phosphor grains 16a in the phosphor film 16 can also contribute to luminescence, the number of the luminescent phosphor grains 16a is increased as a result, and the high-luminance phosphor film 16 is

obtained. The quantity of expensive phosphor powder to be used can be decreased.

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CLAIMS

[Claim(s)]
[Claim 1] The fluorescent substance film (16) consists of an opening (16b) formed between many fluorescent substance particles (16a) and these fluorescent substance particles (16a). Fluorescent substance membrane structure by which said opening (16b) was formed at 40 - 80% of a rate into said fluorescent substance film (16) when the case where said all fluorescent substance film (16a) is filled up with said fluorescent substance particle (16a) without a clearance was made into 100%.
[Claim 2] The fluorescent substance film (36) consists of an ultraviolet-rays transparency particle (36b) of a large number arranged between many fluorescent substance particles (36a) and these fluorescent substance particles (36a). When the case where said fluorescent substance film (36) is altogether filled up with said fluorescent substance particle (36a) without a clearance is made into 100% Fluorescent substance membrane structure whose percentage of occupying in the opening (36c) between said each particle (36a, 36b) and said fluorescent substance film (36) of said ultraviolet-rays transparency particle (36b) is 40 - 80%.
[Claim 3] Fluorescent substance membrane structure according to claim 2 whose ultraviolet-rays transparency particle is a fluoride particle or SiO2 particle.
[Claim 4] Fluorescent substance membrane structure according to claim 2 which is the fluoride particle by which the ultraviolet-rays transparency particle was covered with SiO2 film.
[Claim 5] Fluorescent substance membrane structure according to claim 3 or 4 whose fluoride particle is either CaF2, MgF2 or LiF.
[Claim 6] The paste for forming the fluorescent substance film according to claim 1 characterized by including 0.1 - 16% of the weight of a thermal-expansion nature microcapsule, 15 - 80% of the weight of a fluorescent substance particle, and 80 - 20% of the weight of resin and a solvent.
[Claim 7] The paste for forming the fluorescent substance film according to claim 1 characterized by being refractory or insoluble, and being burned down by 200-500 degrees C to a solvent, and including the resin impalpable powder which is 0.2 - 17 % of the weight whose mean particle diameter is 0.1-20 micrometers, 10 - 80% of the weight of fluorescent substance powder, and 80 - 20% of the weight of a solvent and resin meltable to this solvent.
[Claim 8] Claim 2 thru/or the paste for forming the fluorescent substance film of a publication 5 either characterized by including 0.1 - 50% of the weight of an ultraviolet-rays transparency particle, 10 - 80% of the weight of fluorescent substance powder, and 80 - 20% of the weight of resin and a solvent.
[Claim 9] Claim 1 thru/or the plasma display panel with which the fluorescent substance film (16 36) of a publication was formed in the cel (15) inside between the ribs (14) on a substrate (11) 5 either.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fluorescent substance membrane structure suitable for fluorescence displays, such as a plasma display panel (henceforth PDP), the paste for forming this fluorescent substance film, and PDP using this fluorescent substance film.
[0002]
[Description of the Prior Art] Conventionally, as this kind of fluorescent substance film (it is also called fluorescent substance layer.) structure, as shown in drawing 3 , on the glass substrate 1 of PDP, open predetermined spacing and two or more address electrodes 2 are formed. An insulating layer 3 is formed on a glass substrate 1 so that these address electrodes 2 may be covered, predetermined spacing is opened in insulating-layer 3 top face, two or more ceramic ribs 4 are formed, and what formed the fluorescent substance film 6 in cel 5 inside between these ribs 4 further is known. In order to form this fluorescent substance film, fluorescent substance powder and a vehicle (an organic binder and solvent) are first mixed at a predetermined rate, and a fluorescent substance paste is prepared. Next, a fluorescent substance paste is printed with screen printing etc. to the cel inside divided with two or more ceramic ribs, and at temperature predetermined in the inside of atmospheric air, predetermined time maintenance is carried out and it dries. Furthermore, by carrying out predetermined time maintenance and calcinating at predetermined temperature, in atmospheric air, a vehicle is burned down and the fluorescent substance film is obtained.
[0003] However, in the above-mentioned conventional fluorescent substance membrane structure, since the ultraviolet rays 8 generated by the plasma discharge 7 were irradiated by only fluorescent substance particle 6a of fluorescent substance film 6 front face, fluorescent substance particle 6a in the fluorescent substance film 6 could not contribute to luminescence (fluorescent substance particle 6a smeared away black in drawing 3 has contributed to luminescence.), but there was a problem that brightness was comparatively low. On the other hand, the ultraviolet-rays excitation arc tube (henceforth a fluorescent lamp) which used for the fluorescent screen the luminescence constituent which can reduce the price of photogene remarkably is indicated as a technique near this invention with the technique for canceling these points by using as photogene the constituent which mixed thru/or welded the fluorescent substance particle and the fluoride of alkaline earth metal to JP,1-274354,A, without reducing most brightness of photogene.
[0004]
[Problem(s) to be Solved by the Invention] However, in the fluorescent lamp shown in above-mentioned conventional JP,1-274354,A, although the wavelength of 254nm by luminescence of mercury and 185nm light are used as an excitation light, by PDP, a fluorescent substance is excited by vacuum-ultraviolet light with a wavelength [by luminescence of a xenon] of 147nm. This light is almost absorbed by the fluorescent substance particle, and permeability falls [a fluoride (BaF2, SrF2 grade)]. for this reason, since the amount of ultraviolet rays which invades into the fluorescent substance film was boiled markedly and decreased compared with the fluorescent substance film in a fluorescent lamp, the improvement in luminescence brightness had the trouble of being difficult. The purpose of this invention is by raising the brightness of the fluorescent substance film and reducing the amount of the expensive fluorescent substance powder used by making more fluorescent substance particles in the fluorescent substance film contribute to luminescence to offer PDP using the paste and this fluorescent substance film for forming the fluorescent substance membrane structure which can reduce a manufacturing cost, and this fluorescent substance film, without increasing a manufacture man day.
[0005]
[Means for Solving the Problem] Invention concerning claim 1 is the fluorescent substance membrane structure by which opening 16b was formed at 40 - 80% of a rate into the fluorescent substance film 16, when the case where the

fluorescent substance film 16 consisted of opening 16b formed between much fluorescent substance particle 16a and these fluorescent substance particle 16a as shown in drawing 1 , and the fluorescent substance film 16 is altogether filled up with fluorescent substance particle 16a without a clearance is made into 100%. In the fluorescent substance membrane structure indicated by this claim 1, the ultraviolet rays 18 generated by the plasma discharge 17 excite fluorescent substance particle 16a, and when this fluorescent substance particle returns to a ground state, the light is emitted. Since ultraviolet rays 18 are irradiated by not only fluorescent substance particle 16a of fluorescent substance film 16 front face but fluorescent substance particle 16a in the fluorescent substance film 16 at this time, fluorescent substance particle 16a in the fluorescent substance film 16 can also be contributed to luminescence, and since the fluorescent substance particle number which emits light as a result increases, the fluorescent substance film 16 of high brightness is obtained.

[0006] As invention concerning claim 2 is shown in drawing 2 , the fluorescent substance film 36 consists of ultraviolet-rays transparency particle 36b of a large number arranged between much fluorescent substance particle 36a and these fluorescent substance particle 36a. When the case where the fluorescent substance film 36 is altogether filled up with fluorescent substance particle 36a without a clearance is made into 100%, the rate of occupying in the fluorescent substance film 36 of each particle 36a, opening 36c between 36b, and ultraviolet-rays transparency particle 36b is the fluorescent substance membrane structure which is 40 - 80%. The ultraviolet rays 18 by the plasma discharge 17 excite fluorescent substance particle 36a, and make it emit light in the fluorescent substance membrane structure indicated by this claim 2 (light). Since ultraviolet rays 18 penetrate not only fluorescent substance particle 36a of fluorescent substance film 36 front face but the inside of ultraviolet-rays transparency particle 36b and are irradiated by fluorescent substance particle 36a in the fluorescent substance film 36 at this time Since the fluorescent substance particle number to which fluorescent substance particle 36a in the fluorescent substance film 36 can also be contributed to luminescence, and emits light as a result increases, the fluorescent substance film 36 of high brightness is obtained (fluorescent substance particle 36a smeared away black in drawing 2 has contributed to luminescence.). . Moreover, since the amount of the expensive fluorescent substance powder used can be reduced, a manufacturing cost can be reduced.

[0007] It is desirable to use a fluoride particle or SiO2 particle as the above-mentioned ultraviolet-rays transparency particle. Moreover, if the fluoride particle covered with SiO2 film as an ultraviolet-rays transparency particle is used, the endurance under the plasma of the fluoride particle covered with SiO2 film can be improved. Moreover, as for CaF2, MgF2, and LiF, as a fluoride particle, it is desirable to use whether it is ********. Furthermore, as shown in drawing 1 or drawing 2 , it is desirable to form the above-mentioned fluorescent substance film 16 or 36 in cel 15 inside between the ribs 14 on the substrate 11 of PDP.

[0008]

[Embodiment of the Invention] Next, the gestalt of operation of the 1st of this invention is explained based on a drawing. As shown in drawing 1 , predetermined spacing is opened on the glass substrate 11 of PDP, two or more address electrodes 12 are formed, and on a glass substrate 11, an insulating layer 13 is formed so that these address electrodes 12 may be covered. Moreover, predetermined spacing is opened in insulating-layer 13 top face, two or more ceramic ribs 14 are formed, and the fluorescent substance film 16 is formed in cel 15 inside between these ribs 14. This fluorescent substance film 16 consists of opening 16b formed between much fluorescent substance particle 16a and these fluorescent substance particle 16a, and when the case where the fluorescent substance film 16 is altogether filled up with fluorescent substance particle 16a without a clearance is made into 100%, opening 16b is preferably formed at 50 - 70% of a rate 40 to 80% into the fluorescent substance film 16. Having limited opening 16b to 40 - 80% of range If it becomes difficult at less than 40% to make fluorescent substance particle 16a in the fluorescent substance film 16 contribute to luminescence and 80% is exceeded It is because there are too few amounts of fluorescent substance particle 16a, so there is a possibility that predetermined brightness may not be obtained even if fluorescent substance particle 16a in the fluorescent substance film 16 contributes to luminescence, and the fluorescent substance film 16 may become weak, and brightness may carry out aging.

[0009] Thus, the formation approach of the constituted fluorescent substance film is explained. Fluorescent substance powder, a thermal-expansion nature microcapsule, and resin and a solvent (solvent + plasticizer + dispersant) are first mixed at a predetermined rate, and a fluorescent substance paste is prepared. Fluorescent substance powder is 30 - 60 % of the weight preferably 15 to 80% of the weight, and a thermal-expansion nature microcapsule is 1 - 10 % of the weight preferably 0.1 to 16% of the weight. Moreover, resin and a solvent are 65 - 25 % of the weight preferably 80 to 20% of the weight, resin is specifically 10 - 1 % of the weight preferably 25 to 0% of the weight, and a solvent is 60 - 20 % of the weight preferably 80 to 7% of the weight.

[0010] It is because it becomes difficult for having limited fluorescent substance powder to 15 - 80% of the weight to

make the fluorescent substance particle in the fluorescent substance film contribute to luminescence if predetermined brightness is not obtained but 80 % of the weight is exceeded, since there is too little fluorescent substance powder at less than 15 % of the weight and the effectiveness of this invention is not fully acquired here. Moreover, it is because the reinforcement of the fluorescent substance film will not fully be obtained if having limited the thermal-expansion nature microcapsule to 0.1 - 16% of the weight cannot form opening sufficient in the fluorescent substance film at less than 0.1 % of the weight but 16 % of the weight is exceeded. Furthermore, resin and a solvent were limited to 80 - 20% of the weight because predetermined thickness would not be obtained when the viscosity of a paste becomes low too much, viscosity becomes high too much at less than 20 % of the weight and the fluorescent substance film is formed by print processes etc. if 80 % of the weight is exceeded.

[0011] It is the polymer which resin has a function as a binder, is easy to pyrolyze it, melts into a solvent, and has hyperviscosity, and cellulose system resin (ethyl cellulose, methyl cellulose, etc.), acrylic resin (methyl methacrylic, ethyl methacrylic, etc.), vinyl chloride resin, phenol resin, etc. are mentioned. as a solvent, a nonaqueous solvent (organic solvents, such as an alcoholic system, an ether system, an aromatic series system, and a hydrocarbon system) mentions -- having -- desirable alcohol -- carrying out -- triethylene glycol, a terpineol, etc. are mentioned and diethylether etc. is mentioned as the desirable ether. Furthermore, as a dispersant, dispersants, such as a phosphoric-acid system and a sulfonic acid system, are mentioned. In addition, on these specifications, the above-mentioned resin and a solvent may be called vehicle.

[0012] Moreover, as fluorescent substance powder, the red of 4 - 5 g/cm3 and blue or green fluorescent substance powder are used [mean particle diameter] for specific gravity by 3-4 micrometers. [(Y, Gd) BO3:Eu] powder etc. is used as red fluorescent substance powder, [BaMgAl10O17:Eu] powder etc. is used as blue fluorescent substance powder, and [Zn2SiO4:Mn] powder, [BaAl12O19:Mn] powder, etc. are used as green fluorescent substance powder. Moreover, the microcapsule with a mean particle diameter of 5-8 micrometers which made the acrylonitrile system polymer ****, for example, and connoted the low-boiling point hydrocarbon as a thermal-expansion nature microcapsule is used. Furthermore, as a vehicle, the weight ratio of alpha-terpineol / ethyl cellulose is used for 95/5 of mixture etc., for example.

[0013] On the other hand, on a glass substrate, predetermined spacing is opened by screen printing, the sandblasting method, or the dry film method through an insulating layer, and two or more ceramic ribs are formed. Next, a fluorescent substance paste is printed with screen printing etc. to the cel inside divided with the ceramic rib on the above-mentioned glass substrate, and in atmospheric air, it holds for 10 minutes at 150 degrees C, and dries at them. Furthermore, by holding for 30 minutes at 520 degrees C, and calcinating at them in atmospheric air, the fluorescent substance film with which the opening was formed at 40 - 80% of a rate into the fluorescent substance film is obtained. At this time, as for a thermal-expansion nature microcapsule, the volume expands about 2 to 3 times with evaporation of solvents, such as a low-boiling point hydrocarbon inside a capsule, at the time of desiccation. Moreover, since resinous principles, such as a vehicle and a thermal-expansion nature microcapsule, are burned down at the time of baking, a comparatively big opening is formed into the fluorescent substance film.

[0014] The formation approach of fluorescent substance film other than the above-mentioned formation approach is explained. First, fluorescent substance powder, resin impalpable powder, and resin and a solvent (solvent + plasticizer + dispersant) are mixed at a predetermined rate, and a fluorescent substance paste is prepared. Fluorescent substance powder is 40 - 60 % of the weight preferably ten to 80% of the weight, and resin impalpable powder is 1 - 10 % of the weight preferably 0.2 to 17% of the weight. Fluorescent substance powder was limited to 10 - 80% of the weight because predetermined brightness was not obtained, it would become difficult to make the fluorescent substance particle in the fluorescent substance film contribute to luminescence and the effectiveness of this invention would not fully be acquired at less than 10 % of the weight, if 80 % of the weight is exceeded since there is too little fluorescent substance powder. Moreover, when it becomes difficult to form an opening at 40% of a rate into the fluorescent substance film and 17 % of the weight was exceeded, resin impalpable powder was limited to 0.2 - 17% of the weight at less than 0.2 % of the weight, because an opening will be formed 80% or more into the fluorescent substance film. Furthermore, resin is 10 - 1 % of the weight preferably 25 to 0% of the weight, and a solvent is 60 - 20 % of the weight preferably 80 to 7% of the weight.

[0015] What has the above-mentioned fluorescent substance powder, and resin and a solvent be [the same as that of the above-mentioned formation approach] it is used. Moreover, resin impalpable powder is refractory or insoluble to the solvent to be used, and 200-500 degrees C of destruction-by-fire temperature are 200-400 degrees C preferably, and 1-20 micrometers of mean particle diameter are 0.1-10 micrometers preferably. Here, as for resin impalpable powder, it is desirable to be formed with the resin with which a configuration element consists only of C (carbon), H (hydrogen), and O (oxygen), for example, polyethylene, polyethylene oxide, acrylic resin, a methacryl resin, cellulosic resin,

polystyrene, etc. are mentioned. Moreover, the destruction-by-fire temperature of resin impalpable powder was limited to 200-500 degrees C because it would become difficult at less than 200 degrees C to make resin impalpable powder completely burned down at the time of baking, if resin impalpable powder was burned down at the time of desiccation of a paste and 500 degrees C was exceeded. Furthermore, the mean particle diameter of resin impalpable powder was limited to 0.1-20 micrometers because a bigger opening than the fluorescent substance thickness usually used was formed and the insulator layer of a substrate etc. was seen, if 20 micrometers was exceeded.

[0016] On the other hand, on a glass substrate 11, predetermined spacing is opened by screen printing, the sandblasting method, or the dry film method through an insulating layer 13, and two or more ceramic ribs 14 are formed. Next, a fluorescent substance paste is printed with screen printing etc. to cel 15 inside divided with the ceramic rib 14 on the above-mentioned glass substrate 11, and in atmospheric air, it holds for 10 minutes at 150 degrees C, and dries at them. Furthermore, by holding for 30 minutes at 520 degrees C, and calcinating at them in atmospheric air, the fluorescent substance film 16 with which opening 16b was formed at 40 - 80% of a rate into the fluorescent substance film 16 is obtained. Since the resin impalpable powder which exists among fluorescent substance particle 16a at the time of this baking is burned down, it can form opening 16b at a predetermined rate into the fluorescent substance film 16.

[0017] Thus, when a predetermined electrical potential difference is impressed to the display inter-electrode which it does not illustrate, as shown in drawing 1 , the plasma discharge 17 occurs within a cel 15, and the ultraviolet rays 18 by this plasma discharge 17 excite fluorescent substance particle 16a, and make it emit light in the manufactured fluorescent substance membrane structure (light). Since ultraviolet rays 18 are irradiated by not only fluorescent substance particle 16a of fluorescent substance film 16 front face but fluorescent substance particle 16a in the fluorescent substance film 16 at this time, fluorescent substance particle 16a in the fluorescent substance film 16 can also be contributed to luminescence, and since the fluorescent substance particle number which emits light as a result increases, the fluorescent substance film 16 of high brightness is obtained (fluorescent substance particle 16a smeared away black in drawing 1 has contributed to luminescence.). Moreover, since the amount of the expensive fluorescent substance powder used can be reduced, a manufacturing cost can be reduced.

[0018] The gestalt of operation of the 2nd of this invention is explained based on drawing 2 . In drawing 2 , the same sign as drawing 1 shows the same components. With the gestalt of this operation, the fluorescent substance film 36 formed in the cel 15 between two or more ceramic ribs 14 consists of ultraviolet-rays transparency particle 36b of a large number arranged between much fluorescent substance particle 36a and these fluorescent substance particle 36a. Moreover, when the case where the fluorescent substance film 36 is altogether filled up with fluorescent substance particle 36a without a clearance is made into 100%, the percentage of occupying in the fluorescent substance film 36 of each particle 36a, opening 36c between 36b, and ultraviolet-rays transparency particle 36b is 50 - 70% preferably 40 to 80%. as ultraviolet-rays transparency particle 36b -- a fluoride particle -- desirable -- particles, such as CaF2, MgF2, and LiF, or SiO2 particle -- business -- **** . Moreover, having limited the rate of occupying in the fluorescent substance film 36 of each particle 36a, opening 36c between 36b, and ultraviolet-rays transparency particle 36b to 40 - 80% of range At less than 40%, it is because there are too few amounts of fluorescent substance particle 36a, so predetermined brightness will not be obtained even if fluorescent substance particle 36a in the fluorescent substance film 36 contributes to luminescence if it becomes difficult to make fluorescent substance particle 36a in the fluorescent substance film 36 contribute to luminescence and it exceeds 80%.

[0019] Thus, the formation approach of the constituted fluorescent substance film is explained. A fluorescent substance paste is prepared by mixing fluorescent substance powder, ultraviolet-rays transparency powder, and resin and a solvent at a predetermined rate so that the rate of occupying in the fluorescent substance film 36 of opening 36c between each particle 36a after desiccation / baking and ultraviolet-rays transparency particle 36b may become 40 - 80%. Fluorescent substance powder is 20 - 60 % of the weight preferably ten to 80% of the weight, and an ultraviolet-rays transparency particle is 1 - 30 % of the weight preferably 0.1 to 50% of the weight. Moreover, resin is 10 - 3 % of the weight preferably 25 to 0% of the weight, and a solvent is 60 - 20 % of the weight preferably 80 to 7% of the weight. It is because it becomes difficult for having limited the ultraviolet-rays transparency particle to 0.1 - 50% of the weight to make the fluorescent substance particle in the fluorescent substance film contribute to luminescence less than by 0.1, a fluorescent substance particle will decrease relatively if the effectiveness of this invention is not acquired enough but exceeds 50 % of the weight, and predetermined brightness is not obtained here. Since the formation approach of fluorescent substance film other than the above is the same as that of the gestalt of the 1st operation, and abbreviation, explanation of a repetition is omitted.

[0020] Thus, when a predetermined electrical potential difference is impressed to the display inter-electrode which it does not illustrate, as shown in drawing 2 , the plasma discharge 17 occurs within a cel 15, and ultraviolet rays 18 excite fluorescent substance particle 36a, and make it emit light by this plasma discharge 17 in the manufactured

fluorescent substance membrane structure (light). Since ultraviolet rays 18 penetrate not only fluorescent substance particle 36a of fluorescent substance film 36 front face but the inside of ultraviolet-rays transparency particle 36b and are irradiated by fluorescent substance particle 36a in the fluorescent substance film 36 at this time Since the fluorescent substance particle number to which fluorescent substance particle 36a in the fluorescent substance film 36 can also be contributed to luminescence, and emits light as a result increases, the fluorescent substance film 36 of high brightness is obtained (fluorescent substance particle 36a smeared away black in drawing 2 has contributed to luminescence.). . Moreover, since the amount of the expensive fluorescent substance powder used can be reduced, a manufacturing cost can be reduced.

[0021] In addition, with the gestalt of implementation of the above 2nd, although fluoride particles, such as CaF2, MgF2, and LiF, or SiO2 particle was used as an ultraviolet-rays transparency particle, the fluoride particle covered by SiO2 film may be used. As for the powder which consists of a fluoride particle covered with SiO2 film, it is desirable to be produced by the sol gel process, the CVD method, the sputtering method, etc. The example which produced the powder which consists of CaF2 particle covered with SiO2 film here with the sol gel process is shown. A filter paper is used and filtered, after carrying out specified quantity addition of the CaF2 powder into the solution which mixed ethyl silicate, ethyl alcohol, the hydrochloric acid of predetermined concentration, and isopropyl alcohol the specified quantity every first, and was obtained and agitating for 30 minutes at a room temperature. Next, after holding this filtered powder for 30 minutes at 150 degrees C in atmospheric air and drying, the powder which consists of CaF2 particle covered with SiO2 film is obtained by holding for 1 hour and calcinating at 600 degrees C, among atmospheric air. As for the thickness of this SiO2 film, it is desirable that it is 1-10 micrometers. CaF2 particle is covered with SiO2 film for raising the endurance in the inside of a plasma ambient atmosphere as mentioned above.

[0022]

[Example] Next, the example of this invention is explained in detail with the example of a comparison.

The thermal-expansion nature microcapsule was mixed with 5g for <example 1> fluorescent substance powder, 4.2g was mixed with 0.3g for the vehicle, and the fluorescent substance paste was prepared. The microcapsule with a mean particle diameter of 5-8 micrometers with which specific gravity made acrylonitrile system resin **** as a thermal-expansion nature microcapsule by 3 micrometers, using the red fluorescent substance powder [(Y, Gd) BO3:Eu] of 5.02 g/cm3 as fluorescent substance powder, and mean particle diameter connoted the low-boiling point hydrocarbon was used. Moreover, as a vehicle, the weight ratio of alpha-terpineol / ethyl cellulose used 95/5 of mixture. After screen-stenciling the above-mentioned fluorescent substance paste using the solid screen version of a 1 inch angle in the center of a top face of the soda lime glass substrate of a 2 inch angle and drying for 10 minutes at 150 degrees C, calcinate for 30 minutes at 520 degrees C, and evaporated the low-boiling point hydrocarbon in a microcapsule, and resinous principles, such as a vehicle and a thermal-expansion nature microcapsule, were made burned down, and the fluorescent substance film was obtained. This fluorescent substance film was made into the example 1.

[0023] Except for having mixed the thermal-expansion nature microcapsule with 5g for <example 2> fluorescent substance powder, having mixed 4.2g with 0.6g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 1. This fluorescent substance film was made into the example 2.

CaF2 powder was mixed with 20g for <example 3> fluorescent substance powder, 15g was mixed with 5g for the vehicle, and the fluorescent substance paste was prepared. Fluorescent substance powder and a vehicle used the same object as an example 1. The mean particle diameter of CaF2 powder was 30 micrometers. The above-mentioned fluorescent substance paste was dried and calcinated like the example 1, and the fluorescent substance film was formed on the glass substrate. This fluorescent substance film was made into the example 3.

Except for having mixed CaF2 powder (30 micrometers of mean diameters) with 9g for <example 4> fluorescent substance powder, having mixed 8.5g with 1g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 4.

[0024] Except for having mixed CaF2 powder (30 micrometers of mean diameters) with 10g for <example 5> fluorescent substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 5.

Except for having mixed CaF2 powder (30 micrometers of mean diameters) with 10g for <example 6> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 6.

Except for having mixed MgF2 powder (30 micrometers of mean diameters) with 10g for <example 7> fluorescent substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 7.

[0025] Except for having mixed MgF2 powder (30 micrometers of mean diameters) with 10g for <example 8> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 8.

Except for having mixed LiF powder (30 micrometers of mean diameters) with 10g for <example 9> fluorescent substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 9.

Except for having mixed LiF powder (30 micrometers of mean diameters) with 10g for <example 10> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 10.

[0026] Except for having mixed SiO2 powder (30 micrometers of mean diameters) with 20g for <example 11> fluorescent substance powder, having mixed 15g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 11.

Except for having mixed SiO2 powder (30 micrometers of mean diameters) with 9g for <example 12> fluorescent substance powder, having mixed 8.5g with 1g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 12.

[0027] Except for having mixed SiO2 powder (30 micrometers of mean diameters) with 10g for <example 13> fluorescent substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 13.

Except for having mixed SiO2 powder (30 micrometers of mean diameters) with 10g for <example 14> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 14.

[0028] 10g was mixed [CaF2 powder (30 micrometers of mean diameters) covered with 10g and SiO2 film in <example 15> fluorescent substance powder] with 5g for the vehicle, and the fluorescent substance paste was prepared. CaF2 powder covered with the SiO2 above-mentioned film was produced with the sol gel process. That is, the filter paper was used and filtered, after ethyl alcohol added 50% of the weight, the hydrochloric acid (0.3% of concentration) added the 10g of the CaF2 powder as an example 3 with the isopropyl alcohol same in 50g of 9.2% of the weight of solutions 6% of the weight and ethyl silicate agitated for 30 minutes at the room temperature 34.8% of the weight. CaF2 powder covered with SiO2 film was obtained by calcinating this filtered powder at 600 degrees C after desiccation for 30 minutes by 150 degrees C for 1 hour. The thickness of this SiO2 film was 1 micrometer. The above-mentioned fluorescent substance paste was dried and calcinated like the example 1, and the fluorescent substance film was formed on the glass substrate. This fluorescent substance film was made into the example 15.

Except for having mixed [CaF2 powder (30 micrometers of mean diameters) covered with 10g and SiO2 film in <example 16> fluorescent substance powder] 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the example 15. This fluorescent substance film was made into the example 16.

[0029] CaF2 powder (30 micrometers of mean diameters, specific gravity 3.0 g/cm3) was mixed with 20g for <example 17> fluorescent substance powder, 15g was mixed with 5g for the vehicle, and the fluorescent substance paste was prepared. The weight ratio of alpha-terpineol / ethyl cellulose used [mean particle diameter] 95/5 of mixture as a vehicle, using the green fluorescent substance powder [Zn2SiO4:Mn] of 3.6 micrometers and specific gravity 4.2 g/cm3 as fluorescent substance powder. The above-mentioned fluorescent substance paste was screen-stenciled using the solid screen version of a 1 inch angle in the center of a top face of an alumina substrate with width of face of 1 inch, a die length [of 2 inches], and a thickness of 0.7mm, and it dried for 10 minutes at 150 degrees C. Next, calcinated for 30 minutes at 520 degrees C, the resinous principle in a vehicle was made burned down, and the fluorescent substance

film was obtained. This fluorescent substance film was made into the example 17.

[0030] Except for having mixed CaF2 powder (30 micrometers of mean diameters) with 9g for <example 18> fluorescent substance powder, having mixed 8.5g with 1g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 18.

Except for having mixed CaF2 powder (30 micrometers of mean diameters) with 10g for <example 19> fluorescent substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 19.

Except for having mixed CaF2 powder (30 micrometers of mean diameters) with 10g for <example 20> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 20.

Except for having mixed MgF2 powder (30 micrometers of mean diameters) with 10g for <example 21> fluorescent substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 21.

[0031] Except for having mixed MgF2 powder (30 micrometers of mean diameters) with 10g for <example 22> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 22.

Except for having mixed LiF powder (30 micrometers of mean diameters) with 10g for <example 23> fluorescent substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 23.

Except for having mixed LiF powder (30 micrometers of mean diameters) with 10g for <example 24> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 24.

[0032] Except for having mixed 5g and a thermal-expansion nature microcapsule for fluorescent substance powder, having mixed 4.2g with 0.3g for the vehicle, and having prepared the fluorescent substance paste, without using <example 25> ultraviolet-rays transparency powder, the fluorescent substance film was formed like the example 17. This fluorescent substance film was made into the example 25.

Except for having mixed 5g and a thermal-expansion nature microcapsule for fluorescent substance powder, having mixed 4.2g with 0.6g for the vehicle, and having prepared the fluorescent substance paste, without using <example 26> ultraviolet-rays transparency powder, the fluorescent substance film was formed like the example 17. This fluorescent substance film was made into the example 26.

[0033] Except for having mixed 3.7g and acrylic resin impalpable powder (3 micrometers of mean diameters: Soken Chemical & Engineering make) for fluorescent substance powder, having mixed 3.5g with 0.1g for the vehicle, and having prepared the fluorescent substance paste, without using <example 27> ultraviolet-rays transparency powder, the fluorescent substance film was formed like the example 17. This fluorescent substance film was made into the example 27.

Except for having mixed 2.9g and acrylic resin impalpable powder (3 micrometers of mean diameters: Soken Chemical & Engineering make) for fluorescent substance powder, having mixed 3.0g with 0.3g for the vehicle, and having prepared the fluorescent substance paste, without using <example 28> ultraviolet-rays transparency powder, the fluorescent substance film was formed like the example 17. This fluorescent substance film was made into the example 28.

Except for having mixed 2.1g and acrylic resin impalpable powder (3 micrometers of mean diameters: Soken Chemical & Engineering make) for fluorescent substance powder, having mixed 2.0g with 0.5g for the vehicle, and having prepared the fluorescent substance paste, without using <example 29> ultraviolet-rays transparency powder, the fluorescent substance film was formed like the example 17. This fluorescent substance film was made into the example 29.

[0034] Except for having mixed [the <example 1 of comparison> fluorescent substance powder] 10g with 20g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-

mentioned example 3. This fluorescent substance film was made into the example 1 of a comparison.
Except for having mixed [the <example 2 of comparison> fluorescent substance powder] 10g with 20g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 2 of a comparison.
[0035] The fluorescent substance powder of a comparative study 1, the <evaluation> above-mentioned examples 1-16, and the example 1 of a comparison, ultraviolet-rays transparency powder or a thermal-expansion nature microcapsule, and the addition of a vehicle were shown in Table 1. Moreover, it is the following, and made and asked for the voidage of the fluorescent substance film of examples 1 and 2 and the example 1 of a comparison, and the value was shown in Table 1. The area of the fluorescent substance film, thickness, and baking Shigekazu Ushiro were measured first, and it asked for the consistency of the fluorescent substance film. Next, the value which **(ed) the consistency of this fluorescent substance film by the consistency of a fluorescent substance particle was set to W, and the value which multiplied the value which lengthened Above W from 1 by 100 was made into voidage.
[0036] Moreover, it is the following, and made and asked for the rate that the opening between each particle of the fluorescent substance film of examples 3-16 and an ultraviolet-rays transparency particle occupy, and the value was shown in Table 1. The area of the fluorescent substance film, thickness, and baking Shigekazu Ushiro were measured first, and the weight of the ultraviolet-rays transparency particle contained in the fluorescent substance film from the mixing ratio of fluorescent substance powder and ultraviolet-rays transparency powder was found, and the value which subtracted the weight of this ultraviolet-rays transparency particle from above-mentioned baking Shigekazu Ushiro was set to X, this X was **(ed) by the volume of the fluorescent substance film, and it asked for Y. Next, the value which **(ed) Above Y by the consistency of a fluorescent substance particle was set to Z, and it considered as the rate that the opening between each particle and an ultraviolet-rays transparency particle occupy the value which multiplied the value which lengthened Above Z from 1 by 100. Furthermore, the glass substrate (glass substrate with which the fluorescent substance film was formed in the front face) of examples 1-16 and the example 1 of a comparison was put into the dark room, the ultraviolet rays (wavelength: 254nm) by the low pressure mercury lamp were irradiated at the above-mentioned fluorescent substance film, and the brightness of the fluorescent substance film was measured. Here, it evaluates considering a value when brightness reaches saturation to the increment in the thickness of the fluorescent substance film as brightness of the fluorescent substance film, and the brightness of examples 1-16 is a value when setting the brightness of the example 1 of a comparison to 100. These values were shown in Table 1.
[0037]
[Table 1]

	蛍光体粉末		紫外線透過粉末		熱膨張性マイクロカプセル	ビヒクル	空隙率	各粒子間の空隙及び紫外線透過粒子の占める割合	輝度
	g	色	種類	g	(g)	(g)	(%)	(%)	
実施例 1	5	赤	—	—	0.3	4.2	40	—	110
実施例 2	5	赤	—	—	0.6	4.2	70	—	110
実施例 3	20	赤	CaF_2	5	—	15.0	—	50	107
実施例 4	9	赤	CaF_2	1	—	8.5	—	40	107
実施例 5	10	赤	CaF_2	5	—	10.0	—	65	107
実施例 6	10	赤	CaF_2	10	—	15.0	—	80	105
実施例 7	10	赤	MgF_2	5	—	10.0	—	65	110
実施例 8	10	赤	MgF_2	10	—	15.0	—	80	108
実施例 9	10	赤	LiF	5	—	10.0	—	65	112
実施例10	10	赤	LiF	10	—	15.0	—	80	110
実施例11	20	赤	SiO_2	5	—	15.0	—	60	107
実施例12	9	赤	SiO_2	1	—	8.5	—	55	107
実施例13	10	赤	SiO_2	5	—	10.0	—	65	107
実施例14	10	赤	SiO_2	10	—	15.0	—	75	105
実施例15	10	赤	SiO_2膜で被覆されたCaF_2	5	—	10.0	—	65	105
実施例16	10	赤	SiO_2膜で被覆されたCaF_2	10	—	15.0	—	80	103
比較例 1	20	赤	—	—	—	10.0	30	—	100

[0038] As compared with the fluorescent substance film of the example 1 of a comparison, brightness of fluorescent substance film of examples 1-16 improved 3 to 12% so that clearly from the above-mentioned table 1.
[0039] The rate that the fluorescent substance powder of a comparative study 2, the <evaluation> above-mentioned examples 17-29, and the example 2 of a comparison, ultraviolet-rays transparency powder, a resin bead or a thermal-expansion nature microcapsule, the addition of a vehicle, the voidage between each particle of the fluorescent substance film, or an ultraviolet-rays transparency particle occupies was shown in Table 2. Moreover, the brightness of examples 17-29 and the example 2 of a comparison was measured as follows. The alumina substrate with which the fluorescent substance film was formed first was put into the vacuum chamber, and then it decompressed to 2x10 to 2 or less Torrs with the vacuum pump. Furthermore, the brightness of the fluorescent substance film was measured by irradiating vacuum ultraviolet radiation (wavelength: 146nm) with an excimer lamp (USHIO make: UER20H146) at the above-mentioned fluorescent substance film. Here, it evaluates considering a value when brightness is saturated to the increment in the thickness of the fluorescent substance film as brightness of the fluorescent substance film, and the brightness of examples 17-29 is a value when setting the brightness of the example 2 of a comparison to 100. These values were shown in Table 2.
[0040]
[Table 2]

	蛍光体粉末		紫外線透過粉末		樹脂ビーズ	熱膨張性マイクロカプセル	ヒビクル	空隙率	各粒子間の空隙及び紫外線透過粒子の占める割合	輝度
	g	色	種類	g	(g)	(g)	(g)	(%)	(%)	
実施例17	20	緑	CaF_2	5	—	—	15.0	40	50	115
実施例18	9	緑	CaF_2	1	—	—	8.5	70	40	115
実施例19	10	緑	CaF_2	5	—	—	10.0	—	65	115
実施例20	10	緑	CaF_2	10	—	—	15.0	—	80	112
実施例21	10	緑	MgF_2	5	—	—	10.0	—	65	117
実施例22	10	緑	MgF_2	10	—	—	15.0	—	80	115
実施例23	10	緑	LiF	5	—	—	10.0	—	65	120
実施例24	10	緑	LiF	10	—	—	15.0	—	80	118
実施例25	5	緑	—	—	—	0.3	4.2	40	—	102
実施例26	5	緑	—	—	—	0.6	4.2	70	—	105
実施例27	3.7	緑	—	—	0.1	—	3.5	40	—	105
実施例28	2.9	緑	—	—	0.3	—	3.0	60	—	110
実施例29	2.1	緑	—	—	0.5	—	2.5	80	—	107
比較例 2	10	緑	—	—	—	—	10.0	30	—	100

[0041] As compared with the fluorescent substance film of the example 2 of a comparison, brightness of fluorescent substance film of examples 17-29 improved 2 to 20% so that clearly from the above-mentioned table 2.

[0042]

[Effect of the Invention] As stated above, when the case where the opening formed between many fluorescent substance particles and these fluorescent substance particles constituted the fluorescent substance film, and all fluorescent substance film is filled up with a fluorescent substance particle without a clearance is made into 100% according to this invention By forming an opening at 40 - 80% of a rate into the fluorescent substance film, the ultraviolet rays generated by plasma discharge are irradiated by not only the fluorescent substance particle of a fluorescent substance film front face but the fluorescent substance particle in the fluorescent substance film. Consequently, since the fluorescent substance particle in the fluorescent substance film can also be contributed to luminescence, the fluorescent substance film of high brightness is obtained. Moreover, since the amount of a part with many openings in the fluorescent substance film and the expensive fluorescent substance powder used can be reduced, a manufacturing cost can be reduced.

[0043] Moreover, when the case where many fluorescent substance particles and the ultraviolet-rays transparency particle of a large number arranged among these fluorescent substance particles constituted the fluorescent substance film, and all fluorescent substance film is filled up with a fluorescent substance particle without a clearance is made into 100% The ultraviolet rays which generated the rate of occupying in the opening between each particle and the fluorescent substance film of an ultraviolet-rays transparency particle, by 40 - 80%, then plasma discharge penetrate not only the fluorescent substance particle of a fluorescent substance film front face but the inside of an ultraviolet-rays transparency particle, and are irradiated by the fluorescent substance particle in the fluorescent substance film. Consequently, since the fluorescent substance particle in the fluorescent substance film can also be contributed to luminescence, the fluorescent substance film of high brightness is obtained. Moreover, since the specified quantity of the expensive fluorescent substance powder can be transposed to comparatively cheap ultraviolet-rays transparency powder, a manufacturing cost can be reduced.

[0044] Moreover, if a fluoride particle or SiO2 particle is used as an ultraviolet-rays transparency particle and either CaF2, MgF2 or LiF will be further used as a fluoride particle, the above-mentioned effectiveness can be notably done so. Moreover, if the fluoride particle covered with SiO2 film is used, the endurance in the inside of the plasma ambient atmosphere of this fluoride particle can be improved. Furthermore, if the fluorescent substance film is formed with the paste containing fluorescent substance powder, an ultraviolet-rays transparency particle, a thermal-expansion nature macro capsule or resin impalpable powder, and the resin and the solvent of the specified quantity, the workability

which forms the fluorescent substance film can be improved and a manufacturing cost can be reduced further. If especially the above-mentioned fluorescent substance film is formed in the cel inside between the ribs on the substrate of fluorescence indicating equipments, such as PDP, fluorescence indicating equipments, such as PDP, can be produced easily and simple, and it will greatly contribute in the technical field of relation.

[Translation done.]

* NOTICES *

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3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the fluorescent substance membrane structure suitable for fluorescence displays, such as a plasma display panel (henceforth PDP), the paste for forming this fluorescent substance film, and PDP using this fluorescent substance film.

[Translation done.]

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PRIOR ART

[Description of the Prior Art] Conventionally, as this kind of fluorescent substance film (it is also called fluorescent substance layer.) structure, as shown in drawing 3 , on the glass substrate 1 of PDP, open predetermined spacing and two or more address electrodes 2 are formed. An insulating layer 3 is formed on a glass substrate 1 so that these address electrodes 2 may be covered, predetermined spacing is opened in insulating-layer 3 top face, two or more ceramic ribs 4 are formed, and what formed the fluorescent substance film 6 in cel 5 inside between these ribs 4 further is known. In order to form this fluorescent substance film, fluorescent substance powder and a vehicle (an organic binder and solvent) are first mixed at a predetermined rate, and a fluorescent substance paste is prepared. Next, a fluorescent substance paste is printed with screen printing etc. to the cel inside divided with two or more ceramic ribs, and at temperature predetermined in the inside of atmospheric air, predetermined time maintenance is carried out and it dries. Furthermore, by carrying out predetermined time maintenance and calcinating at predetermined temperature, in atmospheric air, a vehicle is burned down and the fluorescent substance film is obtained.
[0003] However, in the above-mentioned conventional fluorescent substance membrane structure, since the ultraviolet rays 8 generated by the plasma discharge 7 were irradiated by only fluorescent substance particle 6a of fluorescent substance film 6 front face, fluorescent substance particle 6a in the fluorescent substance film 6 could not contribute to luminescence (fluorescent substance particle 6a smeared away black in drawing 3 has contributed to luminescence.), but there was a problem that brightness was comparatively low. On the other hand, the ultraviolet-rays excitation arc tube (henceforth a fluorescent lamp) which used for the fluorescent screen the luminescence constituent which can reduce the price of photogene remarkably is indicated as a technique near this invention with the technique for canceling these points by using as photogene the constituent which mixed thru/or welded the fluorescent substance particle and the fluoride of alkaline earth metal to JP,1-274354,A, without reducing most brightness of photogene.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As stated above, the opening formed between many fluorescent substance particles and these fluorescent substance particles constitutes the fluorescent substance film from this invention, and when the case where all fluorescent substance film is filled up with a fluorescent substance particle without a clearance is made into 100%, an opening is formed at 40 - 80% of a rate into the fluorescent substance film. Therefore, the ultraviolet rays generated by plasma discharge are irradiated by not only the fluorescent substance particle of a fluorescent substance film front face but the fluorescent substance particle in the fluorescent substance film. Consequently, since the fluorescent substance particle in the fluorescent substance film can also be contributed to luminescence, the fluorescent substance film of high brightness is obtained. Moreover, since the amount of a part with many openings in the fluorescent substance film and the expensive fluorescent substance powder used can be reduced, a manufacturing cost can be reduced.

[0043] Moreover, the ultraviolet-rays transparency particle of a large number arranged between many fluorescent substance particles and these fluorescent substance particles in the fluorescent substance film It constitutes, and when the case where all fluorescent substance film is filled up with a fluorescent substance particle without a clearance is made into 100%, the ultraviolet rays which generated the rate of occupying in the opening between each particle and the fluorescent substance film of an ultraviolet-rays transparency particle, by 40 - 80%, then plasma discharge penetrate not only the fluorescent substance particle of a fluorescent substance film front face but the inside of an ultraviolet-rays transparency particle, and are irradiated by the fluorescent substance particle in the fluorescent substance film. Consequently, since the fluorescent substance particle in the fluorescent substance film can also be contributed to luminescence, the fluorescent substance film of high brightness is obtained. Moreover, since the specified quantity of the expensive fluorescent substance powder can be transposed to comparatively cheap ultraviolet-rays transparency powder, a manufacturing cost can be reduced.

[0044] Moreover, if a fluoride particle or SiO2 particle is used as an ultraviolet-rays transparency particle and either CaF2, MgF2 or LiF will be further used as a fluoride particle, the above-mentioned effectiveness can be notably done so. Moreover, if the fluoride particle covered with SiO2 film is used, the endurance in the inside of the plasma ambient atmosphere of this fluoride particle can be improved. Furthermore, if the fluorescent substance film is formed with the paste containing fluorescent substance powder, an ultraviolet-rays transparency particle, a thermal-expansion nature macro capsule or resin impalpable powder, and the resin and the solvent of the specified quantity, the workability which forms the fluorescent substance film can be improved and a manufacturing cost can be reduced further. If especially the above-mentioned fluorescent substance film is formed in the cel inside between the ribs on the substrate of fluorescence indicating equipments, such as PDP, fluorescence indicating equipments, such as PDP, can be produced easily and simple, and it will greatly contribute in the technical field of relation.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in the fluorescent lamp shown in above-mentioned conventional JP,1-274354,A, although the wavelength of 254nm by luminescence of mercury and 185nm light are used as an excitation light, by PDP, a fluorescent substance is excited by vacuum-ultraviolet light with a wavelength [by luminescence of a xenon] of 147nm. This light is almost absorbed by the fluorescent substance particle, and permeability falls [a fluoride (BaF2, SrF2 grade)]. for this reason, since the amount of ultraviolet rays which invades into the fluorescent substance film was boiled markedly and decreased compared with the fluorescent substance film in a fluorescent lamp, the improvement in luminescence brightness had the trouble of being difficult. The purpose of this invention is by raising the brightness of the fluorescent substance film and reducing the amount of the expensive fluorescent substance powder used by making more fluorescent substance particles in the fluorescent substance film contribute to luminescence to offer PDP using the paste and this fluorescent substance film for forming the fluorescent substance membrane structure which can reduce a manufacturing cost, and this fluorescent substance film,.without increasing a manufacture man day.

[Translation done.]

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MEANS

[Means for Solving the Problem] Invention concerning claim 1 is the fluorescent substance membrane structure by which opening 16b was formed at 40 - 80% of a rate into the fluorescent substance film 16, when the case where the fluorescent substance film 16 consisted of opening 16b formed between much fluorescent substance particle 16a and these fluorescent substance particle 16a as shown in drawing 1 , and the fluorescent substance film 16 is altogether filled up with fluorescent substance particle 16a without a clearance is made into 100%. In the fluorescent substance membrane structure indicated by this claim 1, the ultraviolet rays 18 generated by the plasma discharge 17 excite fluorescent substance particle 16a, and when this fluorescent substance particle returns to a ground state, the light is emitted. Since ultraviolet rays 18 are irradiated by not only fluorescent substance particle 16a of fluorescent substance film 16 front face but fluorescent substance particle 16a in the fluorescent substance film 16 at this time, fluorescent substance particle 16a in the fluorescent substance film 16 can also be contributed to luminescence, and since the fluorescent substance particle number which emits light as a result increases, the fluorescent substance film 16 of high brightness is obtained.

[0006] As invention concerning claim 2 is shown in drawing 2 , the fluorescent substance film 36 consists of ultraviolet-rays transparency particle 36b of a large number arranged between much fluorescent substance particle 36a and these fluorescent substance particle 36a. When the case where the fluorescent substance film 36 is altogether filled up with fluorescent substance particle 36a without a clearance is made into 100%, the rate of occupying in the fluorescent substance film 36 of each particle 36a, opening 36c between 36b, and ultraviolet-rays transparency particle 36b is the fluorescent substance membrane structure which is 40 - 80%. The ultraviolet rays 18 by the plasma discharge 17 excite fluorescent substance particle 36a, and make it emit light in the fluorescent substance membrane structure indicated by this claim 2 (light). Since ultraviolet rays 18 penetrate not only fluorescent substance particle 36a of fluorescent substance film 36 front face but the inside of ultraviolet-rays transparency particle 36b and are irradiated by fluorescent substance particle 36a in the fluorescent substance film 36 at this time Since the fluorescent substance particle number to which fluorescent substance particle 36a in the fluorescent substance film 36 can also be contributed to luminescence, and emits light as a result increases, the fluorescent substance film 36 of high brightness is obtained (fluorescent substance particle 36a smeared away black in drawing 2 has contributed to luminescence.). . Moreover, since the amount of the expensive fluorescent substance powder used can be reduced, a manufacturing cost can be reduced.

[0007] It is desirable to use a fluoride particle or SiO2 particle as the above-mentioned ultraviolet-rays transparency particle. Moreover, if the fluoride particle covered with SiO2 film as an ultraviolet-rays transparency particle is used, the endurance under the plasma of the fluoride particle covered with SiO2 film can be improved. Moreover, as for CaF2, MgF2, and LiF, as a fluoride particle, it is desirable to use whether it is ********. Furthermore, as shown in drawing 1 or drawing 2 , it is desirable to form the above-mentioned fluorescent substance film 16 or 36 in cel 15 inside between the ribs 14 on the substrate 11 of PDP.

[0008]

[Embodiment of the Invention] Next, the gestalt of operation of the 1st of this invention is explained based on a drawing. As shown in drawing 1 , predetermined spacing is opened on the glass substrate 11 of PDP, two or more address electrodes 12 are formed, and on a glass substrate 11, an insulating layer 13 is formed so that these address electrodes 12 may be covered. Moreover, predetermined spacing is opened in insulating-layer 13 top face, two or more ceramic ribs 14 are formed, and the fluorescent substance film 16 is formed in cel 15 inside between these ribs 14. This fluorescent substance film 16 consists of opening 16b formed between much fluorescent substance particle 16a and these fluorescent substance particle 16a, and when the case where the fluorescent substance film 16 is altogether filled up with fluorescent substance particle 16a without a clearance is made into 100%, opening 16b is preferably formed at

50 - 70% of a rate 40 to 80% into the fluorescent substance film 16. Having limited opening 16b to 40 - 80% of range If it becomes difficult at less than 40% to make fluorescent substance particle 16a in the fluorescent substance film 16 contribute to luminescence and 80% is exceeded It is because there are too few amounts of fluorescent substance particle 16a, so there is a possibility that predetermined brightness may not be obtained even if fluorescent substance particle 16a in the fluorescent substance film 16 contributes to luminescence, and the fluorescent substance film 16 may become weak, and brightness may carry out aging.

[0009] Thus, the formation approach of the constituted fluorescent substance film is explained. Fluorescent substance powder, a thermal-expansion nature microcapsule, and resin and a solvent (solvent + plasticizer + dispersant) are first mixed at a predetermined rate, and a fluorescent substance paste is prepared. Fluorescent substance powder is 30 - 60 % of the weight preferably 15 to 80% of the weight, and a thermal-expansion nature microcapsule is 1 - 10 % of the weight preferably 0.1 to 16% of the weight. Moreover, resin and a solvent are 65 - 25 % of the weight preferably 80 to 20% of the weight, resin is specifically 10 - 1 % of the weight preferably 25 to 0% of the weight, and a solvent is 60 - 20 % of the weight preferably 80 to 7% of the weight.

[0010] It is because it becomes difficult for having limited fluorescent substance powder to 15 - 80% of the weight to make the fluorescent substance particle in the fluorescent substance film contribute to luminescence if predetermined brightness is not obtained but 80 % of the weight is exceeded, since there is too little fluorescent substance powder at less than 15 % of the weight and the effectiveness of this invention is not fully acquired here. Moreover, it is because the reinforcement of the fluorescent substance film will not fully be obtained if having limited the thermal-expansion nature microcapsule to 0.1 - 16% of the weight cannot form opening sufficient in the fluorescent substance film at less than 0.1 % of the weight but 16 % of the weight is exceeded. Furthermore, resin and a solvent were limited to 80 - 20% of the weight because predetermined thickness would not be obtained when the viscosity of a paste becomes low too much, viscosity becomes high too much at less than 20 % of the weight and the fluorescent substance film is formed by print processes etc. if 80 % of the weight is exceeded.

[0011] It is the polymer which resin has a function as a binder, is easy to pyrolyze it, melts into a solvent, and has hyperviscosity, and cellulose system resin (ethyl cellulose, methyl cellulose, etc.), acrylic resin (methyl methacrylic, ethyl methacrylic, etc.), vinyl chloride resin, phenol resin, etc. are mentioned. as a solvent, a nonaqueous solvent (organic solvents, such as an alcoholic system, an ether system, an aromatic series system, and a hydrocarbon system) mentions -- having -- desirable alcohol -- carrying out -- triethylene glycol, a terpineol, etc. are mentioned and diethylether etc. is mentioned as the desirable ether. Furthermore, as a dispersant, dispersants, such as a phosphoric-acid system and a sulfonic acid system, are mentioned. In addition, on these specifications, the above-mentioned resin and a solvent may be called vehicle.

[0012] Moreover, as fluorescent substance powder, the red of 4 - 5 g/cm3 and blue or green fluorescent substance powder are used [mean particle diameter] for specific gravity by 3-4 micrometers. [(Y, Gd) BO3:Eu] powder etc. is used as red fluorescent substance powder, [BaMgAl10O17:Eu] powder etc. is used as blue fluorescent substance powder, and [Zn2SiO4:Mn] powder, [BaAl12O19:Mn] powder, etc. are used as green fluorescent substance powder. Moreover, the microcapsule with a mean particle diameter of 5-8 micrometers which made the acrylonitrile system polymer ****, for example, and connoted the low-boiling point hydrocarbon as a thermal-expansion nature microcapsule is used. Furthermore, as a vehicle, the weight ratio of alpha-terpineol / ethyl cellulose is used for 95/5 of mixture etc., for example.

[0013] On the other hand, on a glass substrate, predetermined spacing is opened by screen printing, the sandblasting method, or the dry film method through an insulating layer, and two or more ceramic ribs are formed. Next, a fluorescent substance paste is printed with screen printing etc. to the cel inside divided with the ceramic rib on the above-mentioned glass substrate, and in atmospheric air, it holds for 10 minutes at 150 degrees C, and dries at them. Furthermore, by holding for 30 minutes at 520 degrees C, and calcinating at them in atmospheric air, the fluorescent substance film with which the opening was formed at 40 - 80% of a rate into the fluorescent substance film is obtained. At this time, as for a thermal-expansion nature microcapsule, the volume expands about 2 to 3 times with evaporation of solvents, such as a low-boiling point hydrocarbon inside a capsule, at the time of desiccation. Moreover, since resinous principles, such as a vehicle and a thermal-expansion nature microcapsule, are burned down at the time of baking, a comparatively big opening is formed into the fluorescent substance film.

[0014] The formation approach of fluorescent substance film other than the above-mentioned formation approach is explained. First, fluorescent substance powder, resin impalpable powder, and resin and a solvent (solvent + plasticizer + dispersant) are mixed at a predetermined rate, and a fluorescent substance paste is prepared. Fluorescent substance powder is 40 - 60 % of the weight preferably ten to 80% of the weight, and resin impalpable powder is 1 - 10 % of the weight preferably 0.2 to 17% of the weight. Fluorescent substance powder was limited to 10 - 80% of the weight

because predetermined brightness was not obtained, it would become difficult to make the fluorescent substance particle in the fluorescent substance film contribute to luminescence and the effectiveness of this invention would not fully be acquired at less than 10 % of the weight, if 80 % of the weight is exceeded since there is too little fluorescent substance powder. Moreover, when it becomes difficult to form an opening at 40% of a rate into the fluorescent substance film and 17 % of the weight was exceeded, resin impalpable powder was limited to 0.2 - 17% of the weight at less than 0.2 % of the weight, because an opening will be formed 80% or more into the fluorescent substance film. Furthermore, resin is 10 - 1 % of the weight preferably 25 to 0% of the weight, and a solvent is 60 - 20 % of the weight preferably 80 to 7% of the weight.

[0015] What has the above-mentioned fluorescent substance powder, and resin and a solvent be [the same as that of the above-mentioned formation approach] it is used. Moreover, resin impalpable powder is refractory or insoluble to the solvent to be used, and 200-500 degrees C of destruction-by-fire temperature are 200-400 degrees C preferably, and 1-20 micrometers of mean particle diameter are 0.1-10 micrometers preferably. Here, as for resin impalpable powder, it is desirable to be formed with the resin with which a configuration element consists only of C (carbon), H (hydrogen), and O (oxygen), for example, polyethylene, polyethylene oxide, acrylic resin, a methacryl resin, cellulosic resin, polystyrene, etc. are mentioned. Moreover, the destruction-by-fire temperature of resin impalpable powder was limited to 200-500 degrees C because it would become difficult at less than 200 degrees C to make resin impalpable powder completely burned down at the time of baking, if resin impalpable powder was burned down at the time of desiccation of a paste and 500 degrees C was exceeded. Furthermore, the mean particle diameter of resin impalpable powder was limited to 0.1-20 micrometers because a bigger opening than the fluorescent substance thickness usually used was formed and the insulator layer of a substrate etc. was seen, if 20 micrometers was exceeded.

[0016] On the other hand, on a glass substrate 11, predetermined spacing is opened by screen printing, the sandblasting method, or the dry film method through an insulating layer 13, and two or more ceramic ribs 14 are formed. Next, a fluorescent substance paste is printed with screen printing etc. to cel 15 inside divided with the ceramic rib 14 on the above-mentioned glass substrate 11, and in atmospheric air, it holds for 10 minutes at 150 degrees C, and dries at them. Furthermore, by holding for 30 minutes at 520 degrees C, and calcinating at them in atmospheric air, the fluorescent substance film 16 with which opening 16b was formed at 40 - 80% of a rate into the fluorescent substance film 16 is obtained. Since the resin impalpable powder which exists among fluorescent substance particle 16a at the time of this baking is burned down, it can form opening 16b at a predetermined rate into the fluorescent substance film 16.

[0017] Thus, when a predetermined electrical potential difference is impressed to the display inter-electrode which it does not illustrate, as shown in drawing 1 , the plasma discharge 17 occurs within a cel 15, and the ultraviolet rays 18 by this plasma discharge 17 excite fluorescent substance particle 16a, and make it emit light in the manufactured fluorescent substance membrane structure (light). Since ultraviolet rays 18 are irradiated by not only fluorescent substance particle 16a of fluorescent substance film 16 front face but fluorescent substance particle 16a in the fluorescent substance film 16 at this time, fluorescent substance particle 16a in the fluorescent substance film 16 can also be contributed to luminescence, and since the fluorescent substance particle number which emits light as a result increases, the fluorescent substance film 16 of high brightness is obtained (fluorescent substance particle 16a smeared away black in drawing 1 has contributed to luminescence.). Moreover, since the amount of the expensive fluorescent substance powder used can be reduced, a manufacturing cost can be reduced.

[0018] The gestalt of operation of the 2nd of this invention is explained based on drawing 2 . In drawing 2 , the same sign as drawing 1 shows the same components. With the gestalt of this operation, the fluorescent substance film 36 formed in the cel 15 between two or more ceramic ribs 14 consists of ultraviolet-rays transparency particle 36b of a large number arranged between much fluorescent substance particle 36a and these fluorescent substance particle 36a. Moreover, when the case where the fluorescent substance film 36 is altogether filled up with fluorescent substance particle 36a without a clearance is made into 100%, the percentage of occupying in the fluorescent substance film 36 of each particle 36a, opening 36c between 36b, and ultraviolet-rays transparency particle 36b is 50 - 70% preferably 40 to 80%. as ultraviolet-rays transparency particle 36b -- a fluoride particle -- desirable -- particles, such as CaF2, MgF2, and LiF, or SiO2 particle -- business -- **** . Moreover, having limited the rate of occupying in the fluorescent substance film 36 of each particle 36a, opening 36c between 36b, and ultraviolet-rays transparency particle 36b to 40 - 80% of range At less than 40%, it is because there are too few amounts of fluorescent substance particle 36a, so predetermined brightness will not be obtained even if fluorescent substance particle 36a in the fluorescent substance film 36 contributes to luminescence if it becomes difficult to make fluorescent substance particle 36a in the fluorescent substance film 36 contribute to luminescence and it exceeds 80%.

[0019] Thus, the formation approach of the constituted fluorescent substance film is explained. A fluorescent substance paste is prepared by mixing fluorescent substance powder, ultraviolet-rays transparency powder, and resin and a

solvent at a predetermined rate so that the rate of occupying in the fluorescent substance film 36 of opening 36c between each particle 36a after desiccation / baking and ultraviolet-rays transparency particle 36b may become 40 - 80%. Fluorescent substance powder is 20 - 60 % of the weight preferably ten to 80% of the weight, and an ultraviolet-rays transparency particle is 1 - 30 % of the weight preferably 0.1 to 50% of the weight. Moreover, resin is 10 - 3 % of the weight preferably 25 to 0% of the weight, and a solvent is 60 - 20 % of the weight preferably 80 to 7% of the weight. It is because it becomes difficult for having limited the ultraviolet-rays transparency particle to 0.1 - 50% of the weight to make the fluorescent substance particle in the fluorescent substance film contribute to luminescence less than by 0.1, a fluorescent substance particle will decrease relatively if the effectiveness of this invention is not acquired enough but exceeds 50 % of the weight, and predetermined brightness is not obtained here. Since the formation approach of fluorescent substance film other than the above is the same as that of the gestalt of the 1st operation, and abbreviation, explanation of a repetition is omitted.

[0020] Thus, when a predetermined electrical potential difference is impressed to the display inter-electrode which it does not illustrate, as shown in drawing 2 , the plasma discharge 17 occurs within a cel 15, and ultraviolet rays 18 excite fluorescent substance particle 36a, and make it emit light by this plasma discharge 17 in the manufactured fluorescent substance membrane structure (light). Since ultraviolet rays 18 penetrate not only fluorescent substance particle 36a of fluorescent substance film 36 front face but the inside of ultraviolet-rays transparency particle 36b and are irradiated by fluorescent substance particle 36a in the fluorescent substance film 36 at this time Since the fluorescent substance particle number to which fluorescent substance particle 36a in the fluorescent substance film 36 can also be contributed to luminescence, and emits light as a result increases, the fluorescent substance film 36 of high brightness is obtained (fluorescent substance particle 36a smeared away black in drawing 2 has contributed to luminescence.). . Moreover, since the amount of the expensive fluorescent substance powder used can be reduced, a manufacturing cost can be reduced.

[0021] In addition, with the gestalt of implementation of the above 2nd, although fluoride particles, such as CaF2, MgF2, and LiF, or SiO2 particle was used as an ultraviolet-rays transparency particle, the fluoride particle covered by SiO2 film may be used. As for the powder which consists of a fluoride particle covered with SiO2 film, it is desirable to be produced by the sol gel process, the CVD method, the sputtering method, etc. The example which produced the powder which consists of CaF2 particle covered with SiO2 film here with the sol gel process is shown. A filter paper is used and filtered, after carrying out specified quantity addition of the CaF2 powder into the solution which mixed ethyl silicate, ethyl alcohol, the hydrochloric acid of predetermined concentration, and isopropyl alcohol the specified quantity every first, and was obtained and agitating for 30 minutes at a room temperature. Next, after holding this filtered powder for 30 minutes at 150 degrees C in atmospheric air and drying, the powder which consists of CaF2 particle covered with SiO2 film is obtained by holding for 1 hour and calcinating at 600 degrees C, among atmospheric air. As for the thickness of this SiO2 film, it is desirable that it is 1-10 micrometers. CaF2 particle is covered with SiO2 film for raising the endurance in the inside of a plasma ambient atmosphere as mentioned above.

[Translation done.]

* NOTICES *

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EXAMPLE

[Example] Next, the example of this invention is explained in detail with the example of a comparison.
The thermal-expansion nature microcapsule was mixed with 5g for <example 1> fluorescent substance powder, 4.2g was mixed with 0.3g for the vehicle, and the fluorescent substance paste was prepared. The microcapsule with a mean particle diameter of 5-8 micrometers with which specific gravity made acrylonitrile system resin **** as a thermal-expansion nature microcapsule by 3 micrometers, using the red fluorescent substance powder [(Y, Gd) BO3:Eu] of 5.02 g/cm3 as fluorescent substance powder, and mean particle diameter connoted the low-boiling point hydrocarbon was used. Moreover, as a vehicle, the weight ratio of alpha-terpineol / ethyl cellulose used 95/5 of mixture. After screen-stenciling the above-mentioned fluorescent substance paste using the solid screen version of a 1 inch angle in the center of a top face of the soda lime glass substrate of a 2 inch angle and drying for 10 minutes at 150 degrees C, calcinate for 30 minutes at 520 degrees C, and evaporated the low-boiling point hydrocarbon in a microcapsule, and resinous principles, such as a vehicle and a thermal-expansion nature microcapsule, were made burned down, and the fluorescent substance film was obtained. This fluorescent substance film was made into the example 1.
[0023] Except for having mixed the thermal-expansion nature microcapsule with 5g for <example 2> fluorescent substance powder, having mixed 4.2g with 0.6g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 1. This fluorescent substance film was made into the example 2.
CaF2 powder was mixed with 20g for <example 3> fluorescent substance powder, 15g was mixed with 5g for the vehicle, and the fluorescent substance paste was prepared. Fluorescent substance powder and a vehicle used the same object as an example 1. The mean particle diameter of CaF2 powder was 30 micrometers. The above-mentioned fluorescent substance paste was dried and calcinated like the example 1, and the fluorescent substance film was formed on the glass substrate. This fluorescent substance film was made into the example 3.
Except for having mixed CaF2 powder (30 micrometers of mean diameters) with 9g for <example 4> fluorescent substance powder, having mixed 8.5g with 1g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 4.
[0024] Except for having mixed CaF2 powder (30 micrometers of mean diameters) with 10g for <example 5> fluorescent substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 5.
Except for having mixed CaF2 powder (30 micrometers of mean diameters) with 10g for <example 6> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 6.
Except for having mixed MgF2 powder (30 micrometers of mean diameters) with 10g for <example 7> fluorescent substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 7.
[0025] Except for having mixed MgF2 powder (30 micrometers of mean diameters) with 10g for <example 8> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 8.
Except for having mixed LiF powder (30 micrometers of mean diameters) with 10g for <example 9> fluorescent

substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 9.
Except for having mixed LiF powder (30 micrometers of mean diameters) with 10g for <example 10> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 10.
[0026] Except for having mixed SiO2 powder (30 micrometers of mean diameters) with 20g for <example 11> fluorescent substance powder, having mixed 15g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 11.
Except for having mixed SiO2 powder (30 micrometers of mean diameters) with 9g for <example 12> fluorescent substance powder, having mixed 8.5g with 1g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 12.
[0027] Except for having mixed SiO2 powder (30 micrometers of mean diameters) with 10g for <example 13> fluorescent substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 13.
Except for having mixed SiO2 powder (30 micrometers of mean diameters) with 10g for <example 14> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 14.
[0028] 10g was mixed [CaF2 powder (30 micrometers of mean diameters) covered with 10g and SiO2 film in <example 15> fluorescent substance powder] with 5g for the vehicle, and the fluorescent substance paste was prepared. CaF2 powder covered with the SiO2 above-mentioned film was produced with the sol gel process. That is, the filter paper was used and filtered, after ethyl alcohol added 50% of the weight, the hydrochloric acid (0.3% of concentration) added the 10g of the CaF2 powder as an example 3 with the isopropyl alcohol same in 50g of 9.2% of the weight of solutions 6% of the weight and ethyl silicate agitated for 30 minutes at the room temperature 34.8% of the weight. CaF2 powder covered with SiO2 film was obtained by calcinating this filtered powder at 600 degrees C after desiccation for 30 minutes by 150 degrees C for 1 hour. The thickness of this SiO2 film was 1 micrometer. The above-mentioned fluorescent substance paste was dried and calcinated like the example 1, and the fluorescent substance film was formed on the glass substrate. This fluorescent substance film was made into the example 15.
Except for having mixed [CaF2 powder (30 micrometers of mean diameters) covered with 10g and SiO2 film in <example 16> fluorescent substance powder] 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the example 15. This fluorescent substance film was made into the example 16.
[0029] CaF2 powder (30 micrometers of mean diameters, specific gravity 3.0 g/cm3) was mixed with 20g for <example 17> fluorescent substance powder, 15g was mixed with 5g for the vehicle, and the fluorescent substance paste was prepared. The weight ratio of alpha-terpineol / ethyl cellulose used [mean particle diameter] 95/5 of mixture as a vehicle, using the green fluorescent substance powder [Zn2SiO4:Mn] of 3.6 micrometers and specific gravity 4.2 g/cm3 as fluorescent substance powder. The above-mentioned fluorescent substance paste was screen-stenciled using the solid screen version of a 1 inch angle in the center of a top face of an alumina substrate with width of face of 1 inch, a die length [of 2 inches], and a thickness of 0.7mm, and it dried for 10 minutes at 150 degrees C. Next, calcinated for 30 minutes at 520 degrees C, the resinous principle in a vehicle was made burned down, and the fluorescent substance film was obtained. This fluorescent substance film was made into the example 17.
[0030] Except for having mixed CaF2 powder (30 micrometers of mean diameters) with 9g for <example 18> fluorescent substance powder, having mixed 8.5g with 1g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 18.
Except for having mixed CaF2 powder (30 micrometers of mean diameters) with 10g for <example 19> fluorescent substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 19.

Except for having mixed CaF2 powder (30 micrometers of mean diameters) with 10g for <example 20> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 20.

Except for having mixed MgF2 powder (30 micrometers of mean diameters) with 10g for <example 21> fluorescent substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 21.

[0031] Except for having mixed MgF2 powder (30 micrometers of mean diameters) with 10g for <example 22> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 22.

Except for having mixed LiF powder (30 micrometers of mean diameters) with 10g for <example 23> fluorescent substance powder, having mixed 10g with 5g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 23.

Except for having mixed LiF powder (30 micrometers of mean diameters) with 10g for <example 24> fluorescent substance powder, having mixed 15g with 10g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 24.

[0032] Except for having mixed 5g and a thermal-expansion nature microcapsule for fluorescent substance powder, having mixed 4.2g with 0.3g for the vehicle, and having prepared the fluorescent substance paste, without using <example 25> ultraviolet-rays transparency powder, the fluorescent substance film was formed like the example 17. This fluorescent substance film was made into the example 25.

Except for having mixed 5g and a thermal-expansion nature microcapsule for fluorescent substance powder, having mixed 4.2g with 0.6g for the vehicle, and having prepared the fluorescent substance paste, without using <example 26> ultraviolet-rays transparency powder, the fluorescent substance film was formed like the example 17. This fluorescent substance film was made into the example 26.

[0033] Except for having mixed 3.7g and acrylic resin impalpable powder (3 micrometers of mean diameters: Soken Chemical & Engineering make) for fluorescent substance powder, having mixed 3.5g with 0.1g for the vehicle, and having prepared the fluorescent substance paste, without using <example 27> ultraviolet-rays transparency powder, the fluorescent substance film was formed like the example 17. This fluorescent substance film was made into the example 27.

Except for having mixed 2.9g and acrylic resin impalpable powder (3 micrometers of mean diameters: Soken Chemical & Engineering make) for fluorescent substance powder, having mixed 3.0g with 0.3g for the vehicle, and having prepared the fluorescent substance paste, without using <example 28> ultraviolet-rays transparency powder, the fluorescent substance film was formed like the example 17. This fluorescent substance film was made into the example 28.

Except for having mixed 2.1g and acrylic resin impalpable powder (3 micrometers of mean diameters: Soken Chemical & Engineering make) for fluorescent substance powder, having mixed 2.0g with 0.5g for the vehicle, and having prepared the fluorescent substance paste, without using <example 29> ultraviolet-rays transparency powder, the fluorescent substance film was formed like the example 17. This fluorescent substance film was made into the example 29.

[0034] Except for having mixed [the <example 1 of comparison> fluorescent substance powder] 10g with 20g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 3. This fluorescent substance film was made into the example 1 of a comparison.

Except for having mixed [the <example 2 of comparison> fluorescent substance powder] 10g with 20g for the vehicle, and having prepared the fluorescent substance paste, the fluorescent substance film was formed like the above-mentioned example 17. This fluorescent substance film was made into the example 2 of a comparison.

[0035] The fluorescent substance powder of a comparative study 1, the <evaluation> above-mentioned examples 1-16, and the example 1 of a comparison, ultraviolet-rays transparency powder or a thermal-expansion nature microcapsule, and the addition of a vehicle were shown in Table 1. Moreover, it is the following, and made and asked for the voidage of the fluorescent substance film of examples 1 and 2 and the example 1 of a comparison, and the value was shown in Table 1. The area of the fluorescent substance film, thickness, and baking Shigekazu Ushiro were measured first, and it

asked for the consistency of the fluorescent substance film. Next, the value which **(ed) the consistency of this fluorescent substance film by the consistency of a fluorescent substance particle was set to W, and the value which multiplied the value which lengthened Above W from 1 by 100 was made into voidage.

[0036] Moreover, it is the following, and made and asked for the rate that the opening between each particle of the fluorescent substance film of examples 3-16 and an ultraviolet-rays transparency particle occupy, and the value was shown in Table 1. The area of the fluorescent substance film, thickness, and baking Shigekazu Ushiro were measured first, and the weight of the ultraviolet-rays transparency particle contained in the fluorescent substance film from the mixing ratio of fluorescent substance powder and ultraviolet-rays transparency powder was found, and the value which subtracted the weight of this ultraviolet-rays transparency particle from above-mentioned baking Shigekazu Ushiro was set to X, this X was **(ed) by the volume of the fluorescent substance film, and it asked for Y. Next, the value which **(ed) Above Y by the consistency of a fluorescent substance particle was set to Z, and it considered as the rate that the opening between each particle and an ultraviolet-rays transparency particle occupy the value which multiplied the value which lengthened Above Z from 1 by 100. Furthermore, the glass substrate (glass substrate with which the fluorescent substance film was formed in the front face) of examples 1-16 and the example 1 of a comparison was put into the dark room, the ultraviolet rays (wavelength: 254nm) by the low pressure mercury lamp were irradiated at the above-mentioned fluorescent substance film, and the brightness of the fluorescent substance film was measured. Here, it evaluates considering a value when brightness reaches saturation to the increment in the thickness of the fluorescent substance film as brightness of the fluorescent substance film, and the brightness of examples 1-16 is a value when setting the brightness of the example 1 of a comparison to 100. These values were shown in Table 1.

[0037]

[Table 1]

	蛍光体粉末		紫外線透過粉末		熱膨張性マイクロカプセル	ビヒクル	空隙率	各粒子間の空隙及び紫外線透過粒子の占める割合	輝度
	g	色	種類	g	(g)	(g)	(%)	(%)	
実施例 1	5	赤	—	—	0.3	4.2	40	—	110
実施例 2	5	赤	—	—	0.6	4.2	70	—	110
実施例 3	20	赤	CaF_2	5	—	15.0	—	50	107
実施例 4	9	赤	CaF_2	1	—	8.5	—	40	107
実施例 5	10	赤	CaF_2	5	—	10.0	—	65	107
実施例 6	10	赤	CaF_2	10	—	15.0	—	80	105
実施例 7	10	赤	MgF_2	5	—	10.0	—	65	110
実施例 8	10	赤	MgF_2	10	—	15.0	—	80	108
実施例 9	10	赤	LiF	5	—	10.0	—	65	112
実施例10	10	赤	LiF	10	—	15.0	—	80	110
実施例11	20	赤	SiO_2	5	—	15.0	—	60	107
実施例12	9	赤	SiO_2	1	—	8.5	—	55	107
実施例13	10	赤	SiO_2	5	—	10.0	—	65	107
実施例14	10	赤	SiO_2	10	—	15.0	—	75	105
実施例15	10	赤	SiO_2膜で被覆されたCaF_2	5	—	10.0	—	65	105
実施例16	10	赤	SiO_2膜で被覆されたCaF_2	10	—	15.0	—	80	103
比較例 1	20	赤	—	—	—	10.0	30	—	100

[0038] As compared with the fluorescent substance film of the example 1 of a comparison, brightness of fluorescent

substance film of examples 1-16 improved 3 to 12% so that clearly from the above-mentioned table 1.

[0039] The rate that the fluorescent substance powder of a comparative study 2, the <evaluation> above-mentioned examples 17-29, and the example 2 of a comparison, ultraviolet-rays transparency powder, a resin bead or a thermal-expansion nature microcapsule, the addition of a vehicle, the voidage between each particle of the fluorescent substance film, or an ultraviolet-rays transparency particle occupies was shown in Table 2. Moreover, the brightness of examples 17-29 and the example 2 of a comparison was measured as follows. The alumina substrate with which the fluorescent substance film was formed first was put into the vacuum chamber, and then it decompressed to 2x10 to 2 or less Torrs with the vacuum pump. Furthermore, the brightness of the fluorescent substance film was measured by irradiating vacuum ultraviolet radiation (wavelength: 146nm) with an excimer lamp (USHIO make: UER20H146) at the above-mentioned fluorescent substance film. Here, it evaluates considering a value when brightness is saturated to the increment in the thickness of the fluorescent substance film as brightness of the fluorescent substance film, and the brightness of examples 17-29 is a value when setting the brightness of the example 2 of a comparison to 100. These values were shown in Table 2.

[0040]

[Table 2]

	蛍光体粉末		紫外線透過粉末		樹脂ビーズ	熱膨張性マイクロカプセル	ビヒクル	空隙率	各粒子間の空隙及び紫外線透過粒子の占める割合	輝度
	g	色	種類	g	(g)	(g)	(g)	(%)	(%)	
実施例17	20	緑	CaF_2	5	—	—	15.0	40	50	115
実施例18	9	緑	CaF_2	1	—	—	8.5	70	40	115
実施例19	10	緑	CaF_2	5	—	—	10.0	—	65	115
実施例20	10	緑	CaF_2	10	—	—	15.0	—	80	112
実施例21	10	緑	MgF_2	5	—	—	10.0	—	65	117
実施例22	10	緑	MgF_2	10	—	—	15.0	—	80	115
実施例23	10	緑	LiF	5	—	—	10.0	—	65	120
実施例24	10	緑	LiF	10	—	—	15.0	—	80	118
実施例25	5	緑	—	—	—	0.3	4.2	40		102
実施例26	5	緑	—	—	—	0.6	4.2	70	—	105
実施例27	3.7	緑	—	—	0.1	—	3.5	40	—	105
実施例28	2.9	緑	—	—	0.3	—	3.0	60	—	110
実施例29	2.1	緑	—	—	0.5	—	2.5	80	—	107
比較例 2	10	緑	—	—	—	—	10.0	30	—	100

[0041] As compared with the fluorescent substance film of the example 2 of a comparison, brightness of fluorescent substance film of examples 17-29 improved 2 to 20% so that clearly from the above-mentioned table 2.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The important section cross-section block diagram of PDP showing the fluorescent substance membrane structure of the 1st operation gestalt of this invention.
[Drawing 2] The cross-section block diagram corresponding to drawing 1 which shows the fluorescent substance membrane structure of the 2nd operation gestalt of this invention.
[Drawing 3] The cross-section block diagram corresponding to drawing 1 which shows the conventional fluorescent substance membrane structure.
[Description of Notations]
16 36 Fluorescent substance film
16a, 36a Fluorescent substance particle
16b, 36c Opening
36b Ultraviolet-rays transparency particle

[Translation done.]

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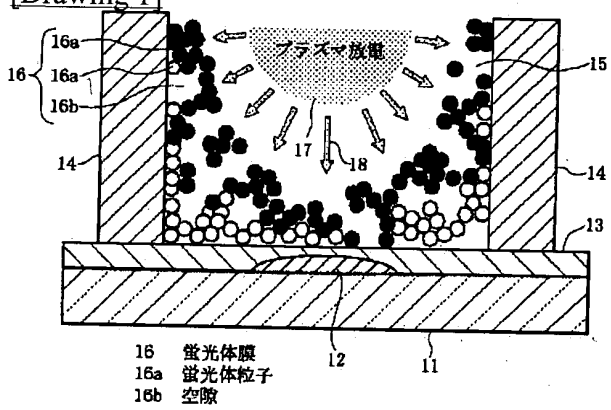
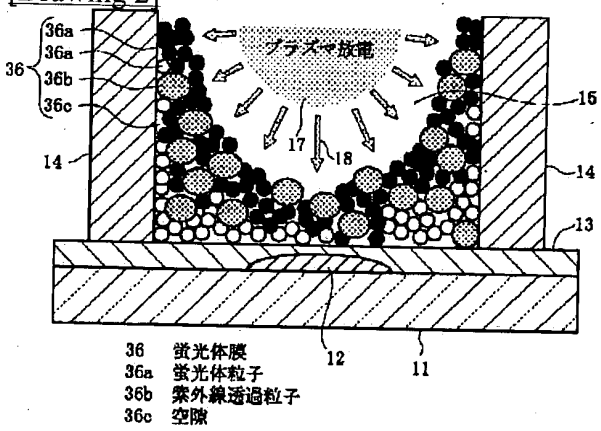
DRAWINGS

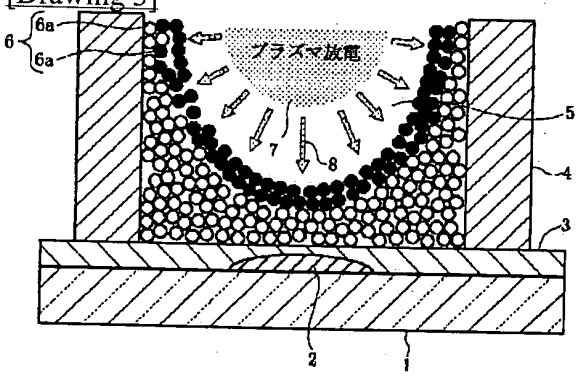
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]